Lemhi River Spring Chinook Salmon Population
Population Viability Assessment

The Lemhi River chinook population (Figure 1) is part of the Snake River Spring/Summer Chinook ESU which has five major population groupings (MPGs): Lower Snake River, Grande Ronde / Imnaha, South Fork Salmon River, Middle Fork Salmon River, and the Upper Salmon River group. The ESU contains both spring and summer run chinook. The Lemhi River population is a spring run and is one of eight extant populations in the Upper Salmon River MPG.

The ICTRT classified the Lemhi River population as a "very large" population (Table 1) based on historical habitat potential (ICTRT 2005). A chinook population classified as very large has a mean minimum abundance threshold criteria of 2000 naturally produced spawners with a sufficient intrinsic productivity to achieve a 5% or less risk of extinction over a 100-year timeframe.

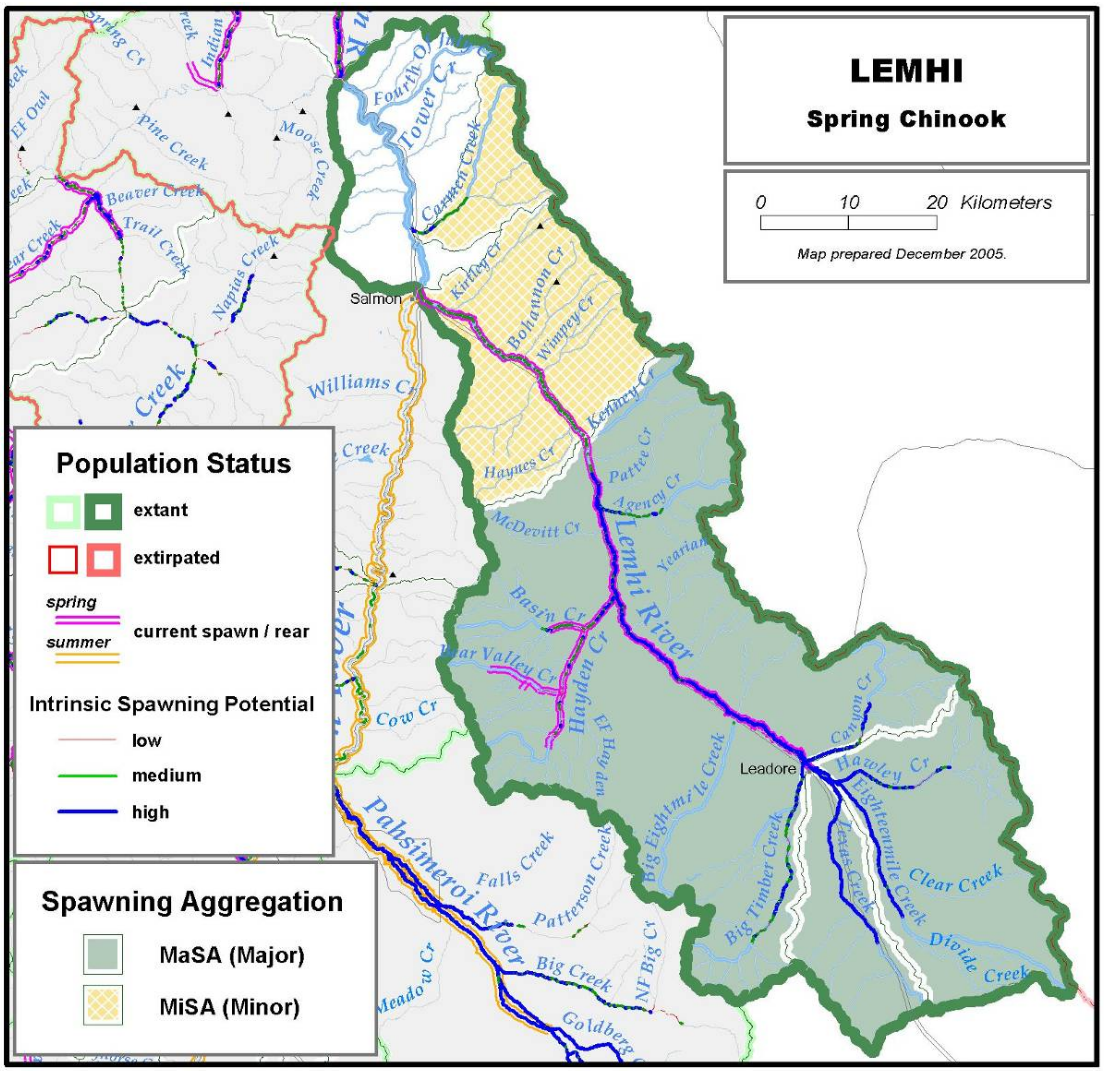

Figure 1. Lemhi River chinook major and minor spawning areas.

Table 1. Lemhi River chinook basin statistics

Drainage Area (km2)	3,812
Stream lengths km* (total)	514
Stream lengths km* (below natural barriers)	422
Branched stream area weighted by intrinsic potential (km2)	1.162
Branched stream area km2 (weighted and temp. limited)	1.162
Total stream area weighted by intrinsic potential (km2)	1.346
Total stream area weighted by intrinsic potential (km2) temp limited	1.346
Size / Complexity category	Very Large / "B" (dendritic structure)
Number of MaSAs	3
Number of MiSAs	2

*All stream segments greater than or equal to 3.8m bankfull width were included
**Temperature limited areas were assessed by subtracting area where the mean weekly modeled water temperature was greater than 22^{o}C.

Current Abundance and Productivity

Current (1957 to 2003) natural abundance (number of adult spawning in natural production areas) has ranged from 10 (1995) to 3,357 (1961, Figure 2). Abundance estimates are based on expanded redd counts (reference). Insert expansion methodology here

Recent year natural spawners include returns originating from naturally spawning parents, and there is no evidence that hatchery strays are entering the population. Spawners originating from naturally spawning parents have comprised an average of 100% since 1953 (Table 2).

Abundance in recent years has been variable, the most recent 10-year geomean number of natural origin spawners was 80 (Table 2). During the period 1979-1998, returns per spawner for chinook in the Secesh River ranged from 0.08 (1990) to 12.01 (1995). The most recent 20 year (1978-1997) SAR adjusted and delimited (at 75% of the size threshold) geometric mean of returns per spawner was 1.08 (Table 2).

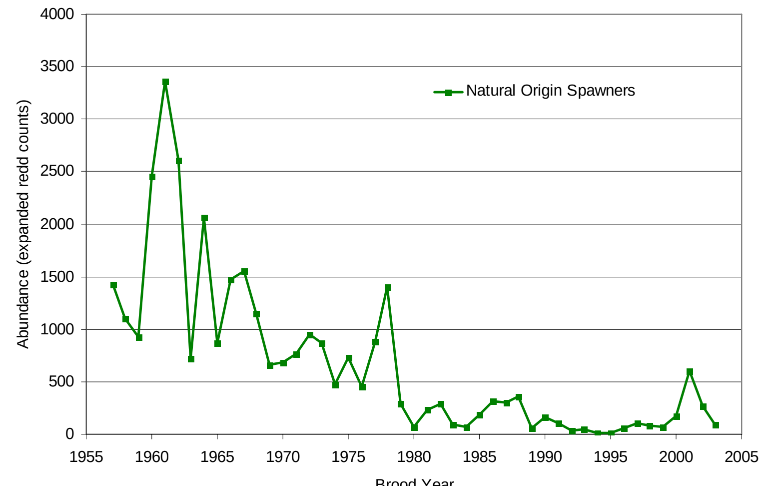

Figure 2. Lemhi River abundance trends 1957-2003.

Table 2. Lemhi River abundance and productivity measures

10-year geomean natural abundance	80
20-year return/spawner productivity	1.09
20-year return/spawner productivity, SAR adj. and delimited*	1.08
20-year Bev-Holt fit productivity, SAR adjusted	n/a
20-year Lambda productivity estimate	1.01
Average proportion natural origin spawners (recent 10 years)	1.0
Reproductive success adj. for hatchery origin spawners	n/a

*Delimited productivity excludes any spawner/return pair where the spawner number exceeds 75% of the size category threshold for this population. This approach attempts to remove density dependence effects that may influence the productivity estimate.

Comparison to the Viability Curve

- Abundance: 10-yr geomean natural origin spawners
- Productivity: 20-yr geomean R/S (adjusted for marine survival and delimited at 1500 spawners)
- Curve: Hockey-Stick curve
- Conclusion: The Lemhi River population is at **HIGH** risk based on current abundance and productivity. The point estimate resides below the 25% risk curve (Figure 3).

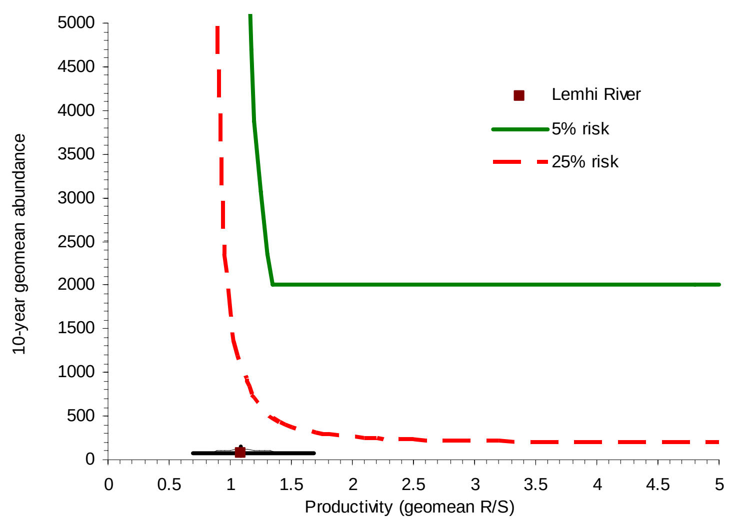

Figure 3. Lemhi River Spring/Summer Chinook abundance and productivity metrics against a Hockey-Stick viability curve. Dataset adjusted for marine survival and delimited at 75% of the size threshold. Estimate includes a 1 SE ellipse, 1.81 X SE abundance line, and 1.72 X SE productivity line.

Spatial Structure and Diversity

The ICTRT has identified three major spawning areas (MaSAs) and two minor spawning areas (MiSAs) within the Lemhi River Spring/Summer Chinook population. Most spawning occurs in the mainstem Lemhi River from the mouth of hayden Creek upstream to the town of Leadore.

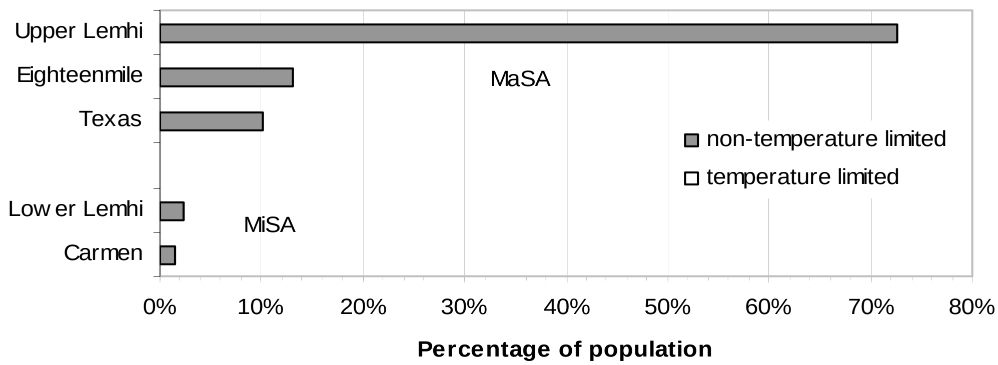

Figure 4. Proportion of major and minor spawning areas that make up the Lemhi River population. There are no modeled temperature limitations for the MiSA/MaSAs in this population.

Factors and Metrics

A.1.a. Number and spatial arrangement of spawning areas.

The Lemhi River spring Chinook salmon population has three MaSAs (Upper Lemhi, Texas, and Eighteen Mile) and two MiSAs (Carmen and Lower Lemhi). This metric is rated *Low Risk* because there are three MaSAs in a non-linear configuration.

A.l.b. Spatial extent or range of population.

The IDFG has conducted annual spawner index counts since 1957 on the mainstem Lemhi River from the town of Lemhi upstream to the town of Leadore. The index area only covers spawning areas in the Upper Lemhi MaSA, not in the Texas and Eighteenmile MaSAs. This metric is rated *High Risk* because current spawning distribution occupies less than 50% of the historic MaSAs

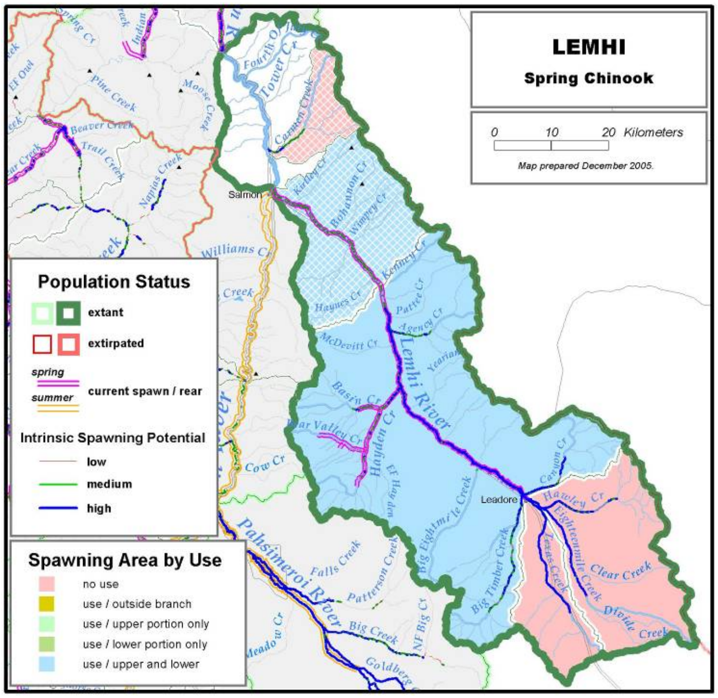

Figure 5. Lemhi River Spring /Summer Chinook distribution.

A.1.c. Increase or decrease in gaps or continuities between spawning areas.
The upper MaSAs are not occupied; fish are precluded from reaching these areas because of irrigation-related impacts (barriers and flow reductions). This metric is rated *High Risk* neither of the two MaSAs in the upstream population area is occupied and the downstream-most MiSA (Carmen) is not occupied.

B.1.a. Major life history strategies.
There are limited data to allow any comparisons between historic and current life history strategies. The major adult life history strategy is spring run timing. The known major juvenile life history strategy is a spring yearling migrant. Substantial anthropogenic impacts have occurred that could have resulted in loss of variability or change in a life history strategy. Modification of the hydrologic regime as a result of irrigation practices and blockage of access to upstream areas may affect variability of life history strategies. There is evidence that the population historically also contained the adult summer run life history strategy, and those fish

primarily spawned in the lower mainstem Lemhi River downstream of Hayden Creek. Based on the evidence that the adult summer run life history strategy has been lost from the population the metric is rated *High Risk*.

B.1.b. Phenotypic variation.

Aside from the loss of the putative adult summer run life history strategy discussed previously, there is no data to indicate that any other phenotypic traits have been significantly changed or lost. Land use activities (flow reductions and blockages resulting from irrigation activities) may impart major selective pressures which would cause significant changes in or loss of traits. Based on the evidence that only one phenotypic trait has been lost from the population; this metric is rated at *Moderate Risk.*

B.1.c. Genetic variation.

Genetic ratings were based on IC-TRT analysis of allozyme data presented in Waples et al. 1993. In addition, the IC-TRT analyzed WDFW and R. Waples, unpublished allozyme data, and P. Moran, unpublished microsatellite data. The samples analyzed were not significantly different from 8 hatchery fish samples. There is moderate inter-annual variation among samples. This metric was rated *Low Risk.* The risk rating is influenced by population size and structural complexity.

B.2.a. Spawner composition.

Spawner composition is determined from spawning ground carcass recoveries. Any marked fish that are recovered are examined for the presence of a coded-wire or PIT tag.
(1) *Out-of-ESU strays*. No out-of-ESU strays have been detected spawning in the population and this sub-metric is rated *Very Low* risk.

(2) *Out-of-MPG strays from within the ESU*. No out-of-MPG strays have been detected spawning in the population, and this sub-metric is rated *Very Low* risk.

(3) *Out of population within MPG strays*. No out-of-population strays have been detected spawning in the population, and this sub-metric is rated *Very Low* risk.

(4) *Within-population hatchery spawners.* There is no within-population hatchery program, and this sub-metric is rated *Very Low Risk.*

The overall risk rating for metric B.2.a “spawner composition” is *Very Low Risk* because no strays or hatchery origin fish have been observed in the population.

B.3.a. Distribution of population across habitat types.

The Lemhi River population intrinsic potential distribution historically was distributed across three EPA level IV ecoregions, with the Dry Intermontane Sagebrush Valleys being predominant. (The Barren Mountains ecoregion was represented in less than 2% of the spawning area, and is excluded from consideration here.) All historically occupied ecoregions are currently occupied (Table 3 and Fig. 6). There are no substantial changes in ecoregion occupancy, and this metric was rated *Low Risk* for the population.

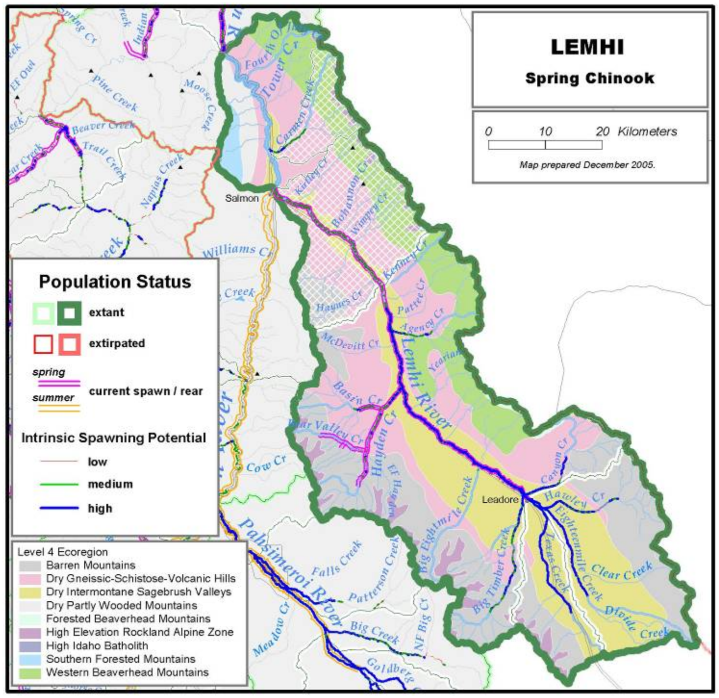

Figure 6. Lemhi River Spring/Summer chinook population distribution across various ecoregions.

Table 3. Lemhi River Spring/Summer Chinook—proportion of spawning areas across various ecoregions.

Ecoregion	% of historical branch spawning area in this ecoregion (non-temperature limited)	% of historical branch spawning area in this ecoregion (temperature limited)	% of currently occupied spawning area in this ecoregion (non-temperature limited)
Barren Mountains	1.8	1.8	0.7
Dry Gneissic-Schistose-Volcanic Hills	4.6	4.6	3.2
Dry Intermontane Sagebrush Valleys	93.5	93.5	96.1

B.4.a. Selective change in natural processes or selective impacts.
Hydropower system: The hydrosystem and associated reservoirs impose some selective mortality on smolt outmigrants and adult migrants, the selective mortality is not likely to remove more than 25% of the affected individuals. The likely impacts are rated as *Low Risk* for this action.

Harvest: Recent harvest impact rates for spring/summer Chinook salmon are generally less than 10% annually. There are no freshwater fisheries directly targeting naturally produced spring/summer Chinook salmon; indirect mortalities are expected to occur in some fisheries selective for hatchery fish. It is not likely that the indirect mortality is selective for a particular group of fish or if it is, it would not select 25% or more of that particular group and this action is as *Very Low Risk*.

Hatcheries: This action is rated *Very Low Risk*. There are no hatchery programs or hatchery fish that affect this population.

Habitat: It is unknown to what extent habitat alterations may have resulted in selective change on the population. Access to the upper two MaSAs was blocked as a result of irrigation-related effects. Because two of the three MaSAs were completely affected by habitat actions and all fish in the affected MaSAs were selected against, this metric is rated *High Risk*.

Spatial Structure and Diversity Summary

Overall spatial structure and diversity has been rated *High Risk* for the Lemhi River population (Table 4). This risk rating is influenced by the lack of occupancy of historically used habitat and the loss of a life history strategy.

Table 4. Spatial structure and diversity scoring table

Metric	Risk Assessment Scores				
	Metric	Factor	Mechanism	Goal	Population
A.1.a	L (1)	L (1)	High Risk (Mean=-0.33)	High Risk	**High Risk**
A.1.b	H (-1)	H (-1)			
A.1.c	H (-1)	H (-1)			
B.1.a	H (-1)	H (-1)	High Risk (-1)	High Risk	
B.1.b	M (0)	M (0)			
B.1.c	L (1)	L (1)			
B.2.a(1)	VL (2)	Very Low Risk (2)	Very Low Risk (2)		
B.2.a(2)	VL (2)				
B.2.a(3)	VL (2)				
B.2.a(4)	VL (2)				
B.3.a	L (1)	L (1)	Low Risk (1)		
B.4.a	H (-1)	H (-1)	High Risk (-1)		

Overall Viability Rating

The Lemhi River spring/summer Chinook salmon population does not currently meet viability criteria because neither Abundance/Productivity risk nor Spatial Structure/Diversity risk meets the criteria for a viable population (Table 5). The 20-year delimited recruit per spawner point estimate essentially is at replacement (1.08), and is significantly less than the 1.45 required at the minimum threshold abundance. The 10-year geometric mean abundance (80) is only 4% of the minimum threshold abundance. Substantial improvements in abundance/productivity status (reduction of risk level) and spatial structure/diversity status will need to occur before the population can be considered viable.

		Spatial Structure/Diversity Risk			
		Very Low	**Low**	**Moderate**	**High**
Abundance/ Productivity Risk	**Very Low** (<1%)	**HV**	**HV**	**V**	M
	Low (1-5%)	**V**	**V**	**V**	M
	Moderate (6 – 25%)	M	M	M	
	High (>25%)				**Lemhi**

Figure 7. Viable Salmonid Population parameter risk ratings for the Lemhi River Spring Chinook salmon population. This population does not currently meet viability criteria. *Viability Key: HV – Highly Viable; V – Viable; M – Maintained; Shaded cells-- not meeting viability criteria (darkest cells are at greatest risk)*

Lemhi River Spring Chinook – Data Summary

Data type: Redd count expansions
SAR: Averaged Williams/CSS series

Table 5. Lemhi River Spring Chinook run data (used for curve fits and R/S analysis). All available data since 1979 were used in the productivity calculation since the parent escapement was never above 1500.

Brood Year	Spawners	%Wild	Natural Run	Nat. Rtns	R/S	Rel. SAR	Adj. Rtns	Adj. R/S
1979	**289**	**1**	**289**	**82**	**0.28**	**0.9**	**71**	**0.25**
1980	**64**	**1**	**64**	**127**	**1.99**	**0.6**	**74**	**1.16**
1981	**228**	**1**	**228**	**246**	**1.08**	**0.6**	**155**	**0.68**
1982	**295**	**1**	**295**	**308**	**1.04**	**0.5**	**157**	**0.53**
1983	**91**	**1**	**91**	**331**	**3.63**	**0.6**	**191**	**2.09**
1984	**69**	**1**	**69**	**208**	**3.01**	**1.7**	**345**	**4.97**
1985	**184**	**1**	**184**	**114**	**0.62**	**1.6**	**179**	**0.97**
1986	**311**	**1**	**311**	**133**	**0.43**	**1.4**	**187**	**0.60**
1987	**307**	**1**	**307**	**70**	**0.23**	**1.8**	**127**	**0.41**
1988	**354**	**1**	**354**	**38**	**0.11**	**0.7**	**29**	**0.08**
1989	**63**	**1**	**63**	**30**	**0.47**	**1.8**	**53**	**0.84**
1990	**158**	**1**	**158**	**12**	**0.08**	**4.7**	**57**	**0.36**
1991	**109**	**1**	**109**	**34**	**0.31**	**3.0**	**102**	**0.93**
1992	**30**	**1**	**30**	**78**	**2.62**	**1.7**	**129**	**4.33**
1993	**46**	**1**	**46**	**89**	**1.95**	**1.6**	**143**	**3.13**
1994	**14**	**1**	**14**	**74**	**5.37**	**1.0**	**78**	**5.61**
1995	**10**	**1**	**10**	**119**	**12.01**	**0.6**	**71**	**7.20**
1996	**57**	**1**	**57**	**100**	**1.73**	**0.5**	**54**	**0.94**
1997	**99**	**1**	**99**	**702**	**7.09**	**0.3**	**208**	**2.10**
1998	**79**	**1**	**79**	**204**	**2.57**	**0.3**	**60**	**0.76**
1999	69	1	69					
2000	168	1	168					
2001	607	1	607					
2002	270	1	270					
2003	94	1	94					

Table 6. Geomean abundance and productivity measures. Abundance and productivity values used in the current status assessment are boxed.

	R/S measures				Lambda measures		Abundance
	Not adjusted		SAR adjusted		Not adjusted		Nat. origin
delimited	median	75% threshold	median	75% threshold	1987-1998	1979-1998	geomean
Point Est.	2.61	1.09	2.29	$\boxed{1.08}$	1.02	1.02	$\boxed{80}$
Std. Err.	0.26	0.31	0.27	0.26	0.54	0.35	0.36
count	10	20	10	20	12	20	10

Table 7. Poptools stock-recruitment curve fit parameter estimates.

	Not adjusted for SAR							Adjusted for SAR						
SR Model	a	SE	b	SE	adj. var	auto	AICc	a	SE	b	SE	adj. var	auto	AICc
Rand-Walk	1.09	0.33	n/a	n/a	1.21	0.58	73.7	1.08	0.27	n/a	n/a	1.01	0.44	65.9
Const. Rec	104	21	n/a	n/a	n/a	n/a	58.0	104	14	n/a	n/a	n/a	n/a	40.8
Bev-Holt	50.00	199.70	108	28	0.45	0.69	60.8	23.84	36.40	112	20	0.30	0.37	43.1
Hock-Stk	10.44	10.45	10	10	0.44	0.69	60.8	1.08	0.18	1613	0	1.01	0.44	68.6
Ricker	3.70	1.31	0.00857	0.00196	0.63	0.58	63.0	3.54	0.82	0.00829	0.00128	0.36	0.30	46.0

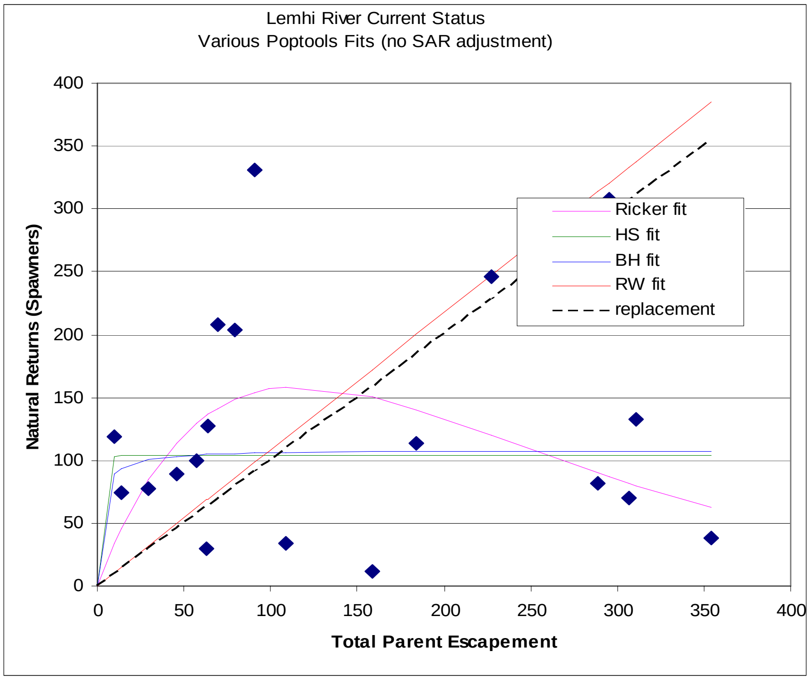

Figure 8. Stock recruitment curves for the Lemhi River Spring/Summer Chinook population. Data not adjusted for marine survival. Points used in the current productivity calculation are bolded (all data are used for this population).

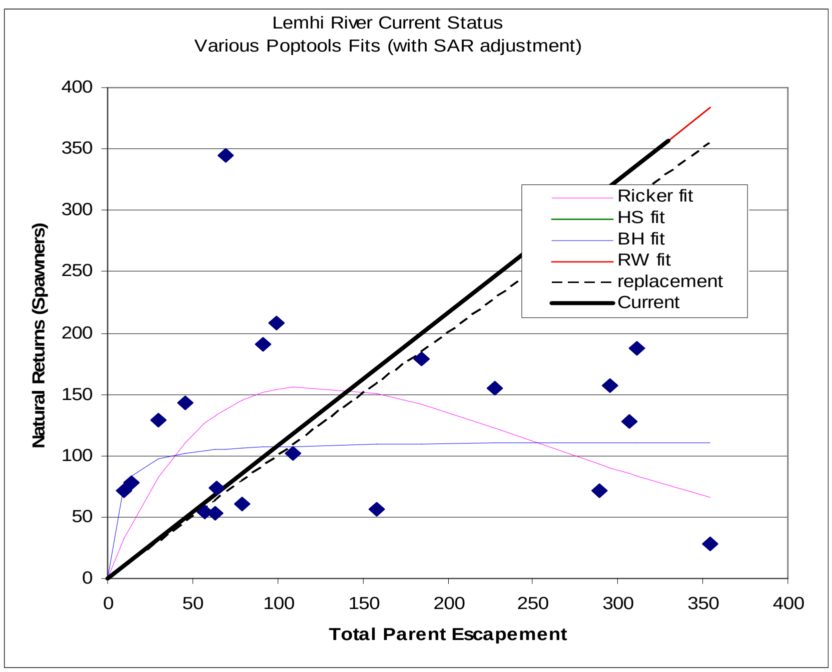

Figure 9. Stock-recruitment curves for the Lemhi River Spring/Summer Chinook population. Data adjusted for marine survival. Points used in the current productivity calculation are bolded (all data are used for this population).